



**PATENT COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY**  
 (Chapter II of the Patent Cooperation Treaty)  
 (PCT Article 36 and Rule 70)

Applicant's or agent's file reference P03038	<b>FOR FURTHER ACTION</b>  See Form PCT/PEA416	
International application No. PCT/NO2004/000350	International filing date (day/month/year) 15.11.2004	Priority date (day/month/year) 26.11.2003
International Patent Classification (IPC) or national classification and IPC C25C3/06		
Applicant NORSK HYDRO ASA et al.		
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 4 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p style="margin-left: 20px;">a. <input type="checkbox"/> sent to the applicant and to the International Bureau a total of sheets, as follows:</p> <p style="margin-left: 40px;"><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p style="margin-left: 40px;"><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p style="margin-left: 20px;">b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>		
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>		
Date of submission of the demand  13.06.2005	Date of completion of this report  02.09.2005	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2339 - 0 Tx: 523656 epmu d Fax: +49 89 2339 - 4465	Authorized Officer  Hammerstein, G  Telephone No. +49 89 2339-8175 	

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/NO2004/000350

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**Box No. I Basis of the report**

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1. With regard to the language, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

1-8 as originally filed

**Claims, Numbers**

1-10 as originally filed

**Drawings, Sheets**

1/1 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
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International application No.  
PCT/NO2004/000350

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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**1. Statement**

Novelty (N)	Yes: Claims	1-10
	No: Claims	
Inventive step (IS)	Yes: Claims	1-10
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-10
	No: Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

The document US-A-4221641 is regarded as being the closest prior art to the subject-matter of claims 1 and 4 in that it discloses (column 3, line 7 to column 4, line 60 and column 8, line 55 to column 9, line 3) a method and apparatus for replacing spent anodes in an aluminium electrolysis cell. The apparatus comprises a crane and gripping means for removing and inserting the anodes and an optical passage detector for detecting the presence of the anode at particular levels. From the difference in levels the insertion height of the new anode can be determined. A laser beam may be used as an additional optical detector.

The feature distinguishing the subject-matter of claims 1 and 4 is the equipment for determining the length of the spent anode and the new anode and the combination with a PLC to determine the insertion height of the new anode from the measured data.

The subject-matter of independent claims 1 and 4 is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as providing a precise positioning equipment which is interfaceable with a microprocessor.

The solution to this problem proposed in claims 1 and 4 of the present application is considered as involving an inventive step (Article 33(3) PCT) since it is not suggested by the prior art documents.

Claims 2-3 and 5-10 are dependent on claims 1 and 4 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

It would appear that the present application rightfully claims its priority date such that US2004/0211663 is not considered as state of the art relevant under Article 33 PCT.

important to avoid anode deformation. The additional height means that the anode does not draw "full power", and it is allowed to heat up gradually before full current flows through it.

#### Claims

1. A method for positioning when replacing anodes in an electrolysis cell of Hall-Héroult type with prebaked anodes, in which a crane with an anode gripper is used to lift out used anodes and to insert new anodes, the gripper act in a predetermined, fixed point in the hanger of the anodes, and in which a new anode is inserted at a height in accordance with a calculated height based on the height of the anode removed, the height of the anode removed and the height of the new anode being measured against a common reference level, characterised in that laser-based measuring equipment for length measurements is arranged between a point on the crane, which is stationary in terms of height during the operation, and a point on the anode gripper, which moves together with the anode, that the equipment measures the heights stated and that the measured values are processed by a PLC-based system, which determines the insertion height of the new anode in accordance with a specific algorithm.
2. A method in accordance with claim 1, characterised in that the algorithm comprises the following formula:

$$D=A-B+C-X,$$

where:

D is the desired position of the new anode.  
 A is the position of the used anode in the cell.  
 B is the position of the used anode on the reference level.  
 C is the position of the new anode on the same reference level.  
 X is the additional height for insertion of the new anode in relation to the used anode.

3. A method in accordance with claim 1, characterised in that, before the height stated is measured, play is eliminated in the anode gripper and connected mechanical structures in the crane by the anode gripper being subjected to a first lifting force that is less than the weight of the burned-out anode.
4. Equipment for positioning when replacing anodes in

an electrolysis cell of Hall-Héroult type with prebaked anodes, comprising a crane with an anode gripper to lift out used anodes and to insert new anodes, the gripper acts in a predefined point of the anode's hanger, with which a new anode is inserted at a height in accordance with a calculated height based on the height of the anode removed, the height of the anode removed and the height of the new anode being measured against a common reference level, characterised in that laser-based measuring equipment for length measurements is arranged between a point on the crane, which is stationary in terms of height during the operation, and a point on the anode gripper, which moves together with the anode, and that the equipment measures the heights stated and transfers the data signals to a PLC, which processes measured, saved values and determines the insertion height of the new anode in accordance with a specific algorithm.

5. Equipment in accordance with claim 4, characterised in that the laser-based measuring equipment comprises a laser cell, which both emits laser light and detects reflected laser light and which is mounted at a location that is stationary in terms of height on the crane and that a reflective device for reflection of the laser light is mounted on the anode gripper.
6. Equipment in accordance with claim 5, characterised in that the laser cell is contained in a dust-tight cabinet with a downward-facing opening, to which is attached a tube through which the laser light passes.
7. Equipment in accordance with claim 6, characterised in that the cabinet is supplied with compressed air to establish air overpressure so that dust cannot reach up into the cabinet via the tube.
8. Equipment in accordance with claim 7, characterised in that the PLC is arranged so that the measured values transferred are stored and processed after interlocking to eliminate play.
9. Equipment in accordance with claim 8, characterised in that the interlocking involves the anode gripper being subjected to a lifting force equivalent to 60-70% of the weight of the anode, and that this must be applied for at least 2 seconds before the measurement can be stored.
10. Equipment in accordance with claims 8-9, characterised in that

a display, a light signal or similar visualises the completion of the sequence in accordance with the method and interlocking specified, and that measured values are saved in accordance with this.

#### Patentansprüche

1. Positionierungsverfahren beim Auswechseln von Anoden in einer Elektrolyse-Zelle vom Typ Hall-Héroult mit vorgebrannten Anoden, wobei ein Kran mit einem Anodengreifer zum Herausheben von gebrauchten Anoden und zum Einführen von neuen Anoden benutzt wird, wobei die Greifer an einem vorbestimmten, festen Punkt in den Anodenträger agieren und wobei eine neue Anode an einer Höhe gemäß einer errechneten Höhe basierend auf der Höhe der entfernten Anode eingeführt wird, wobei die Höhe der entfernten Anode und die Höhe der neuen Anode mithilfe einer gemeinsamen Bezugsebene gemessen werden, dadurch gekennzeichnet, dass ein laserbasiertes Messgerät für Längenmessungen zwischen einem Punkt auf dem Kran angeordnet ist, der während des Betriebs in Bezug auf die Höhe stationär ist, und einem Punkt auf dem Anodengreifer angeordnet ist, das sich gemeinsam mit der Anode bewegt, und dadurch, dass das Gerät die genannten Höhen misst, und dass die gemessenen Werte von einem System auf PLC-Basis verarbeitet werden, das die Einführhöhe der neuen Anode gemäß einem spezifischen Algorithmus bestimmt.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, dass der Algorithmus die folgende Formel umfasst:

$$D=A-B+C-X,$$

wobei

D der gewünschten Position der neuen Anode  
A der Position der gebrauchten Anode in der Zelle  
B der Position der gebrauchten Anode auf der Bezugsebene  
C der Position der neuen Anode auf der gleichen Bezugsebene  
X der zusätzlichen Einführhöhe der neuen Anode in Bezug auf die gebrauchte Anode entspricht.

3. Verfahren nach Anspruch 1, dadurch gekennzeichnet, dass vor dem Messen der genannten Höhe das Spiel in dem Anodengreifer und den verbundenen mechanischen Strukturen im Kran beseitigt werden, indem der Anodengreifer einer ersten Hubkraft ausgesetzt wird, die geringer als das Gewicht der ausgebrannten

ten Anode ist.

4. Positionierungsgerät beim Auswechseln von Anoden in einer Elektrolyse-Zelle vom Typ Hall-Héroult mit vorgebrannten Anoden umfassend einen Kran mit einem Anodengreifer zum Herausheben von gebrauchten Anoden und zum Einführen von neuen Anoden, wobei der Greifer an einem vorbestimmten Punkt des Anodenträgers agiert, mit dem eine neue Anode an einer Höhe gemäß einer errechneten Höhe basierend auf der Höhe der entfernten Anode eingeführt wird, wobei die Höhe der entfernten Anode und die Höhe der neuen Anode auf einer gemeinsamen Bezugsebene gemessen werden, dadurch gekennzeichnet, dass das laserbasierte Messgerät für Längenmessungen zwischen einem Punkt auf dem Kran angeordnet ist, der während des Betriebs in Bezug auf die Höhe stationär ist, und einem Punkt auf dem Anodengreifer, der sich gemeinsam mit der Anode bewegt, und dadurch, dass das Gerät die genannten Höhen misst und die Datensignale an eine PLC übermittelt, welche die gemessenen, gespeicherten Werte verarbeitet und die Einführhöhe der neuen Anode gemäß einem spezifischen Algorithmus bestimmt.
5. Gerät nach Anspruch 4, dadurch gekennzeichnet, dass das laserbasierte Messgerät eine Laserzelle umfasst, die sowohl Laserlicht ausstrahlt als auch reflektiertes Laserlicht erkennt, und die an einer Stelle angeordnet ist, die in Bezug auf die Höhe auf dem Kran stationär ist und dadurch, dass eine Reflektionsvorrichtung zur Reflexion von Laserlicht an dem Anodengreifer angeordnet ist.
6. Gerät nach Anspruch 5, dadurch gekennzeichnet, dass die Laserzelle in einem staubdichten Gehäuse mit einer nach unten gerichteten Öffnung enthalten ist, an der ein Rohr befestigt ist, durch das das Laserlicht hindurchstrahlt.
7. Gerät nach Anspruch 6, dadurch gekennzeichnet, dass das Gehäuse mit Druckluft versorgt wird, um einen Luftüberdruck zu erzeugen, so dass kein Staub durch das Rohr hindurch hinauf in das Gehäuse gelangen kann.
8. Gerät nach Anspruch 7, dadurch gekennzeichnet, dass die PLC so angeordnet ist, dass die übermittelten gemessenen Werte gespeichert werden und nach dem Eingriff zur Beseitigung von Spiel verarbeitet werden.
9. Gerät nach Anspruch 8, dadurch gekennzeichnet,